Overview of the SMS (v11.0), Coastal Modeling System, and User Resources

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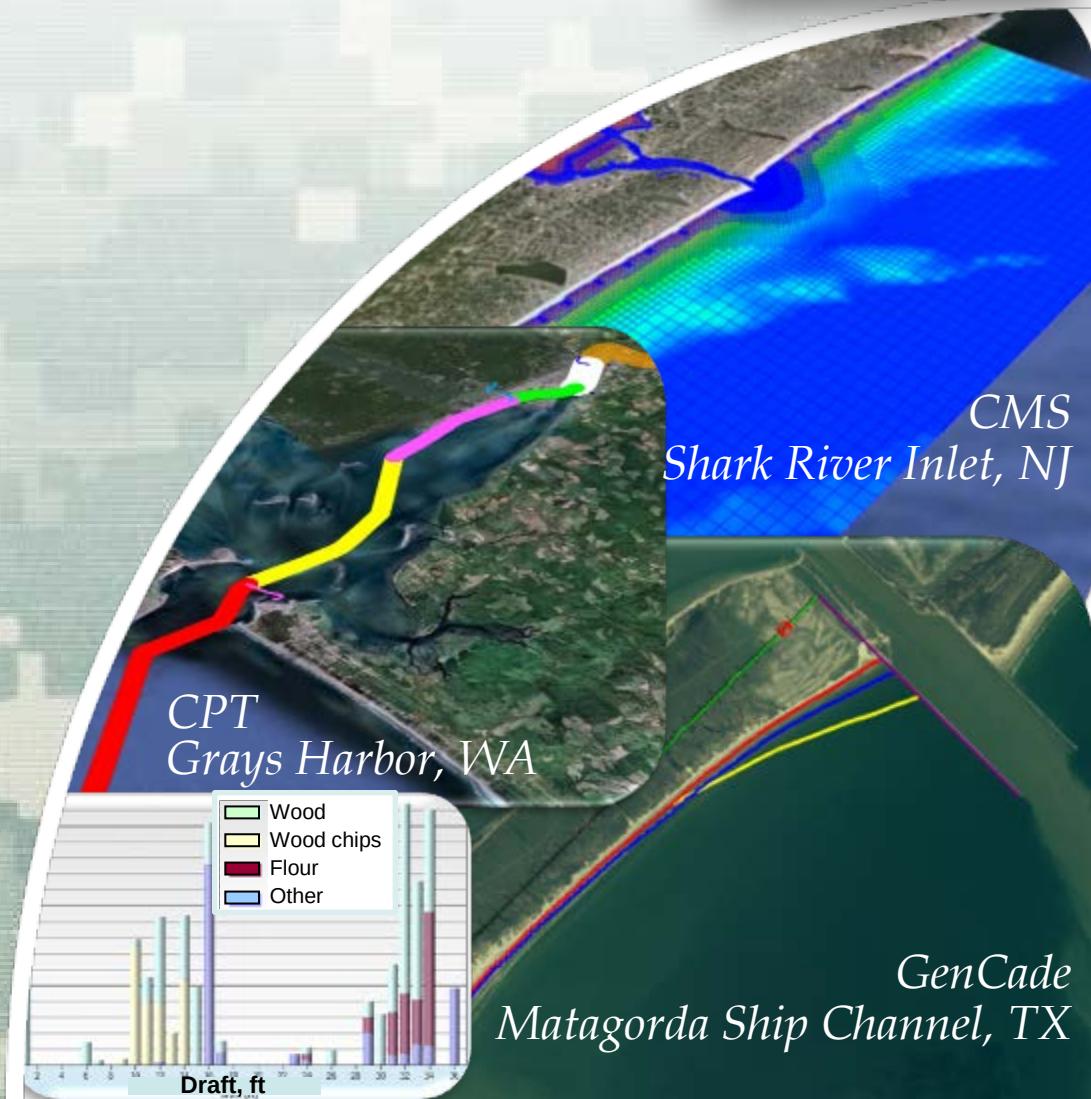
June 11-15, 2012



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1st CMS Webinar, Coastal Inlets Research Program, June 11-15, 2012.

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15. SUBJECT TERMS

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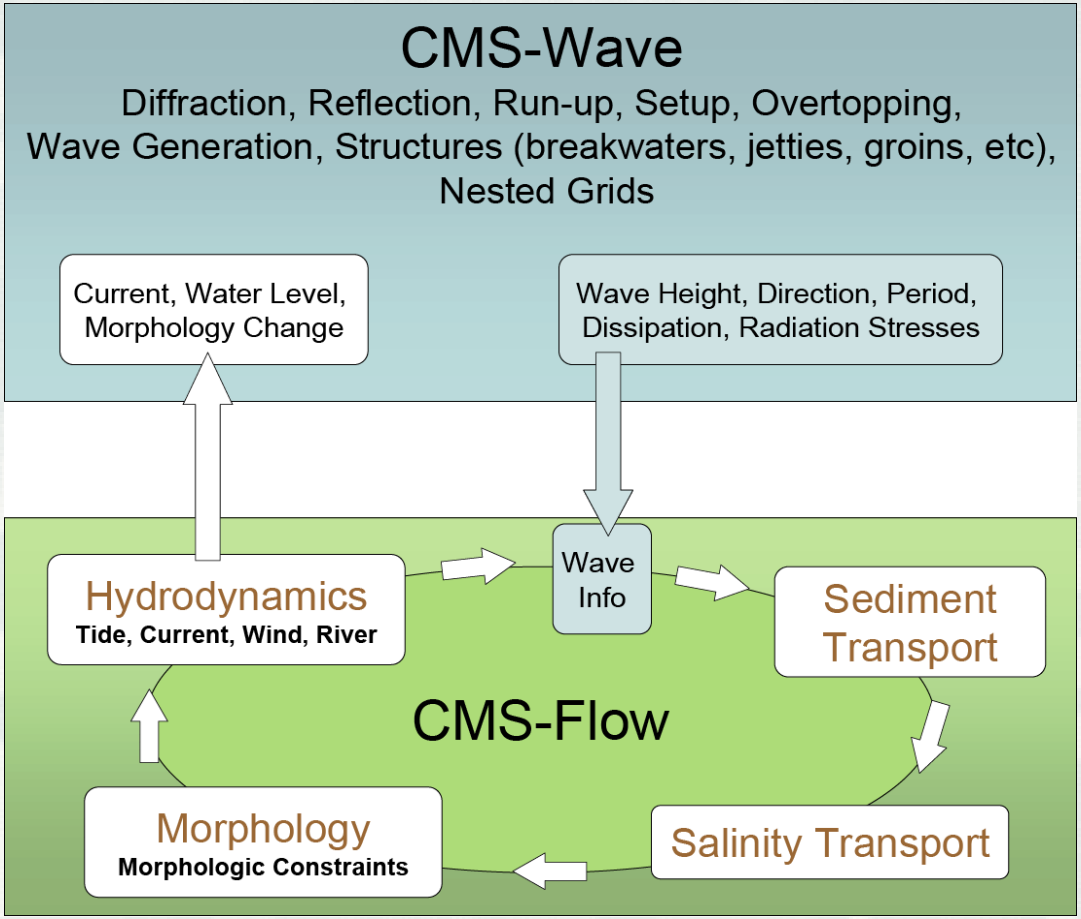
Overview of Presentation

- Introduction to the Coastal Modeling System (CMS)
  - CMS-Flow – Hydrodynamics, Sediment Transport, Morphology Change
  - CMS-Wave – Half-plane waves and Full-plane wind forcing.

Objective

- **Deliver** to engineers' desktops **integrated** advanced models that can be used as **practical** engineering tools for **coastal** inlet and adjacent beach studies.
  - Integrated: All relevant processes, models efficiently coupled together
  - Practical: PC-based, user-friendly interface, fast, robust and accurate
  - Deliver: Manuals, tech reports, journal papers, Wiki, workshops, phone help, etc.

CMS Overview



Since 1997…

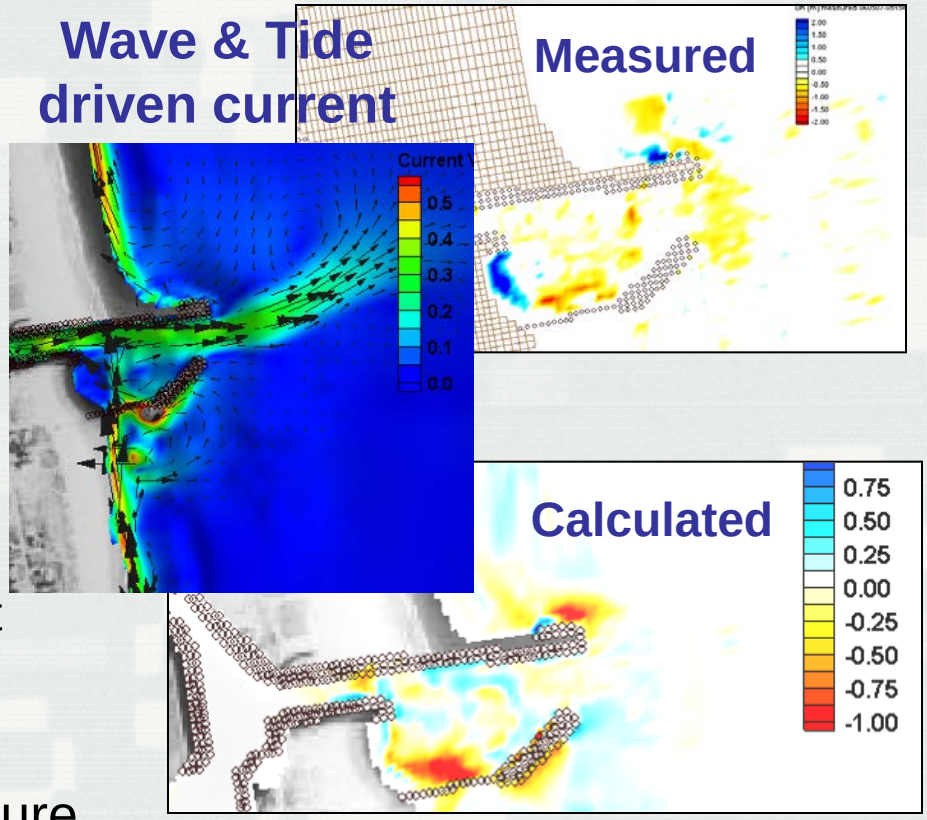
- 2 webinars
- 38 workshops
- Districts can independently run the CMS!

Advantages…

- Robust
- Physics-based
- Integrated SYSTEM
- In SMS
- User-friendly

CMS-Flow Key Features

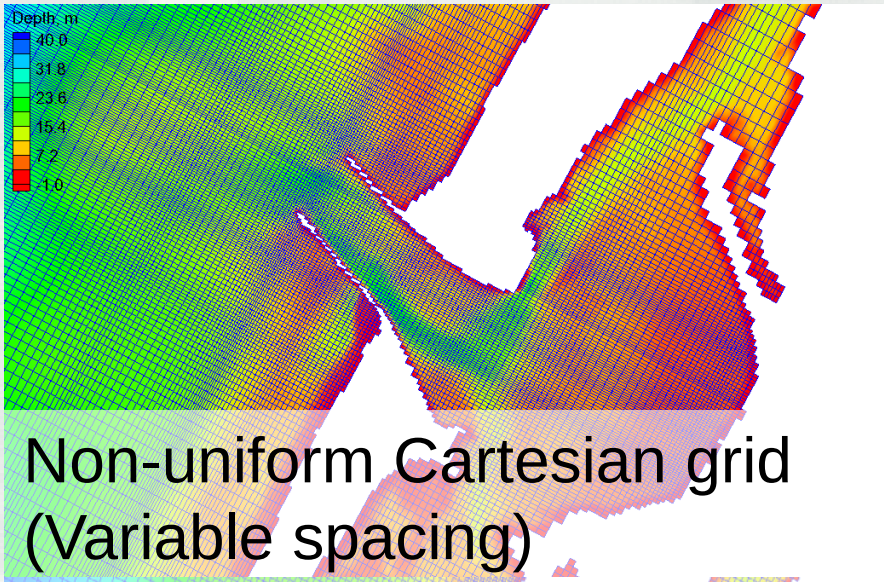
- Finite Volume Method
  - Conserves mass
  - Stable
  - Accessible
- Coupled with spectral wave model (CMS-Wave)
  - Wave-current interactions
- Inline sediment transport and morphology change
  - Non-equilibrium sediment Transport model (NET)
- Nesting capability
- WSE, river, wind/atmospheric pressure forcing
- Tidal constituent forcing (NEW)



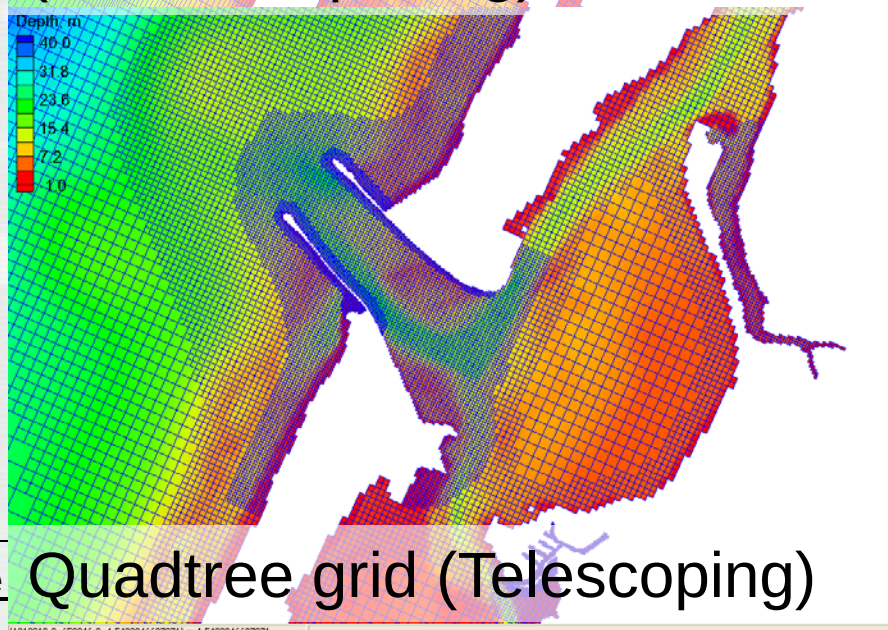
CMS-Flow Key Features

- Grid options
  - Non-uniform Cartesian grid: Easy to setup
  - Quadtree (telescoping) grid: Efficient, flexible (presently, only available for Implicit model)
- Solver options
  - Implicit: Tidal flow, long-term morphology change, parallel processing.

    ~5 - 30 minute time step
  - Explicit: Flooding, breaching, super-critical flow. ~1 second time step, parallel processing



Non-uniform Cartesian grid (Variable spacing)



Quadtree grid (Telescoping)

Hydrodynamics

Included terms for the depth-averaged shallow water equations in Cartesian coordinates

Depth - averaged current velocity

Total water depth

Still water depth

Water surface elevation

Gravity

Atmospheric Pressure

Precipitation / Evaporation

Coriolis

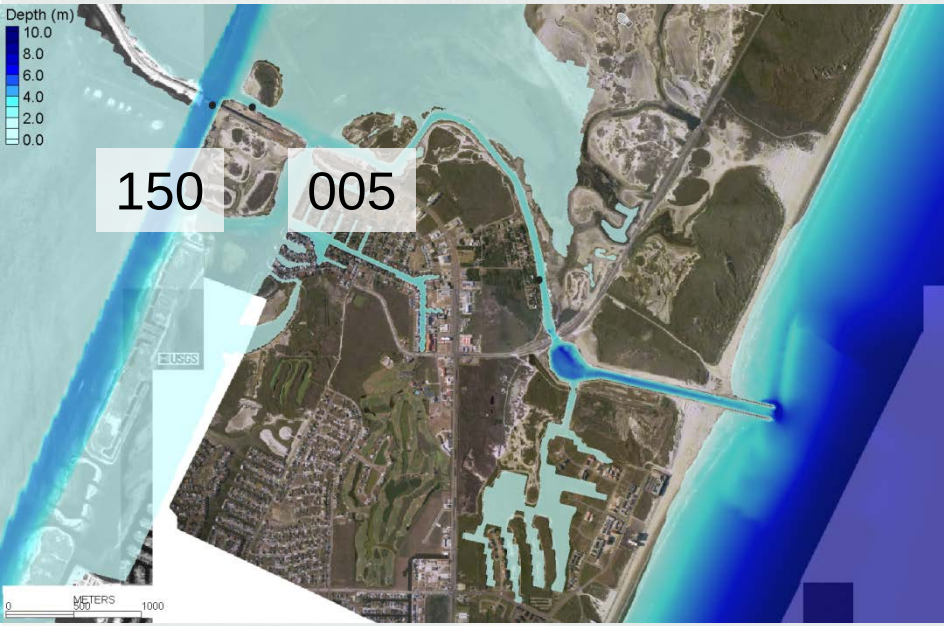
Turbulent eddy viscosity

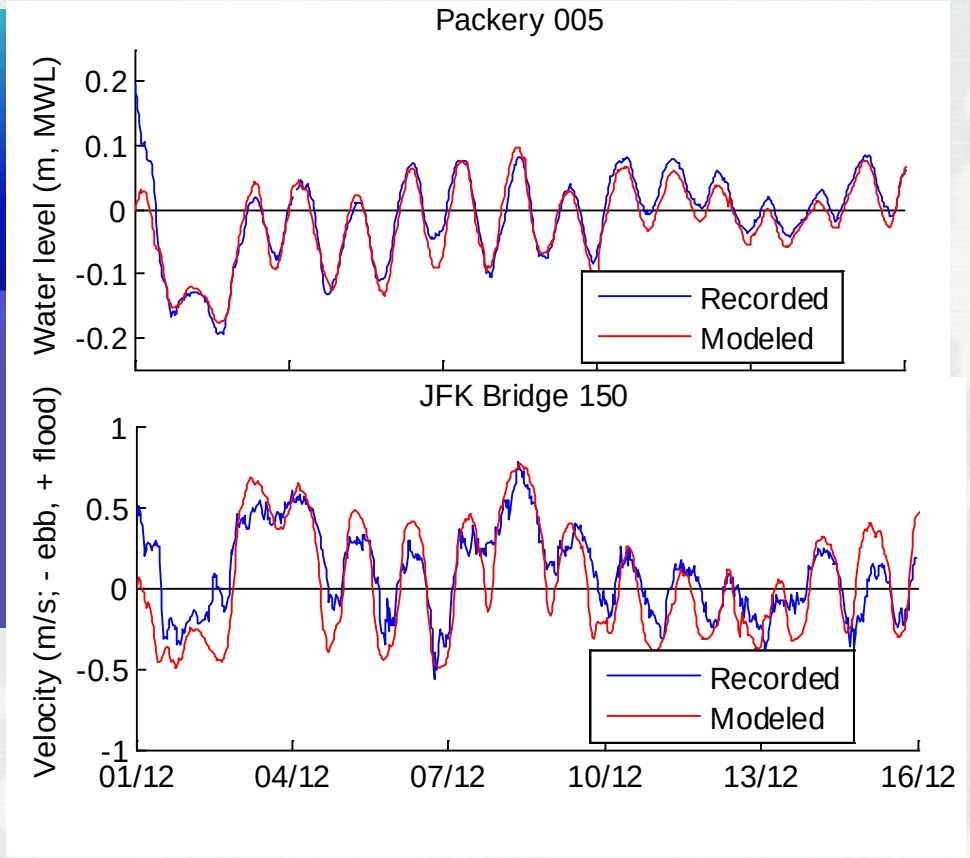
Bottom stress (including waves)

Wave stress (forcing)

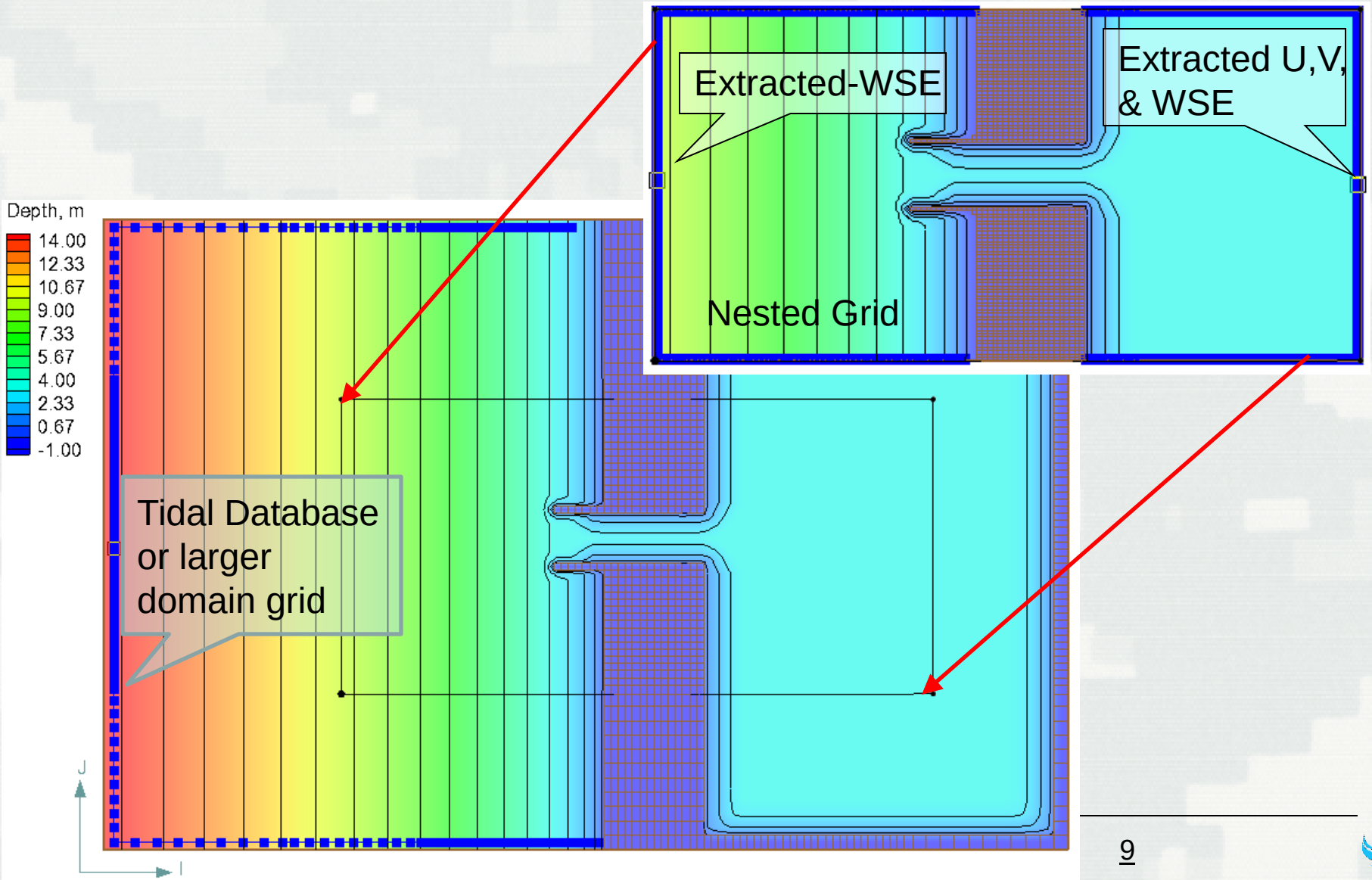
Wind stress

Packery Channel, TX



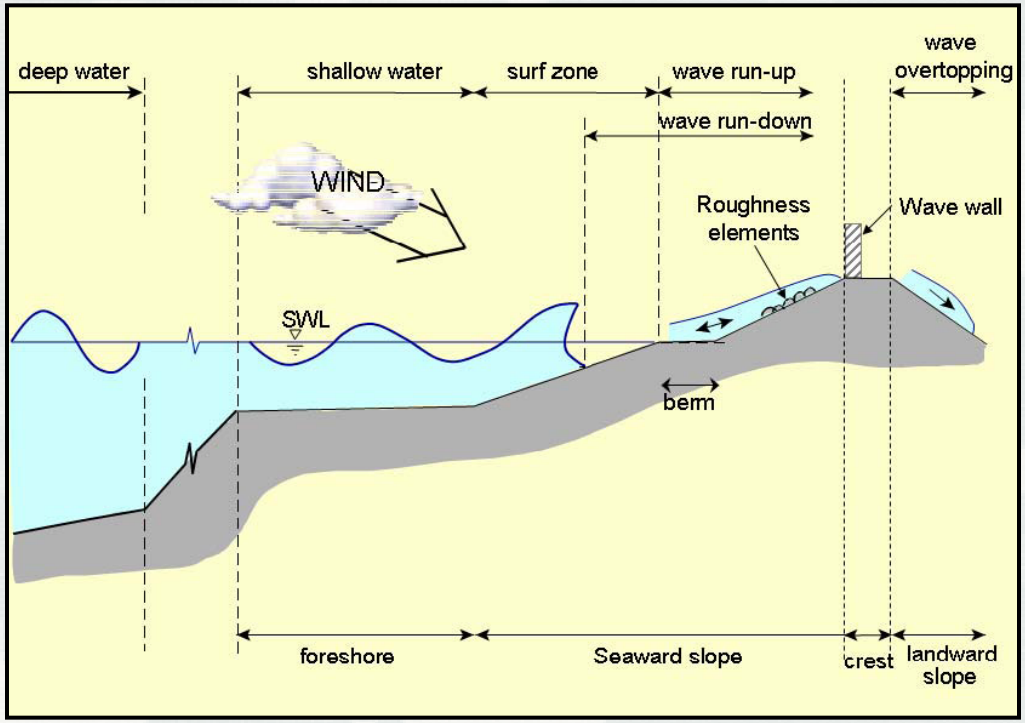


Nested Grid Capability

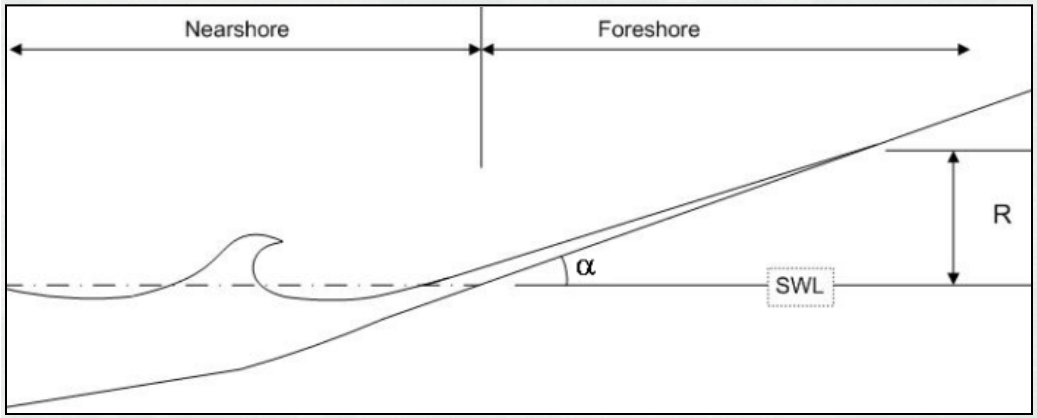


CMS-Wave: Key Features

- Shoaling, refraction, diffraction, reflection
- Bottom friction
- White capping
- Wave breaking (4 options)
- Wind generation
- Wave-current, and wave-wave interactions
- Transmission, runup and overtopping
- Muddy bottom
- Automatic grid rotation
- Non-uniform Cartesian grid with nesting capability
- “Fast Mode”



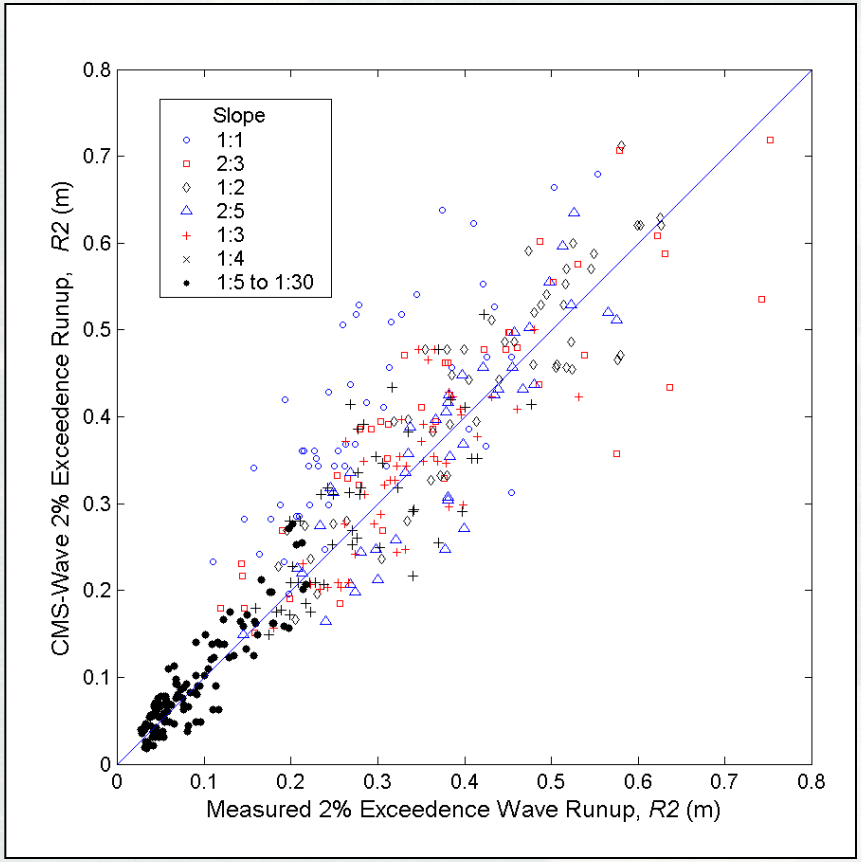
Wave Run-up



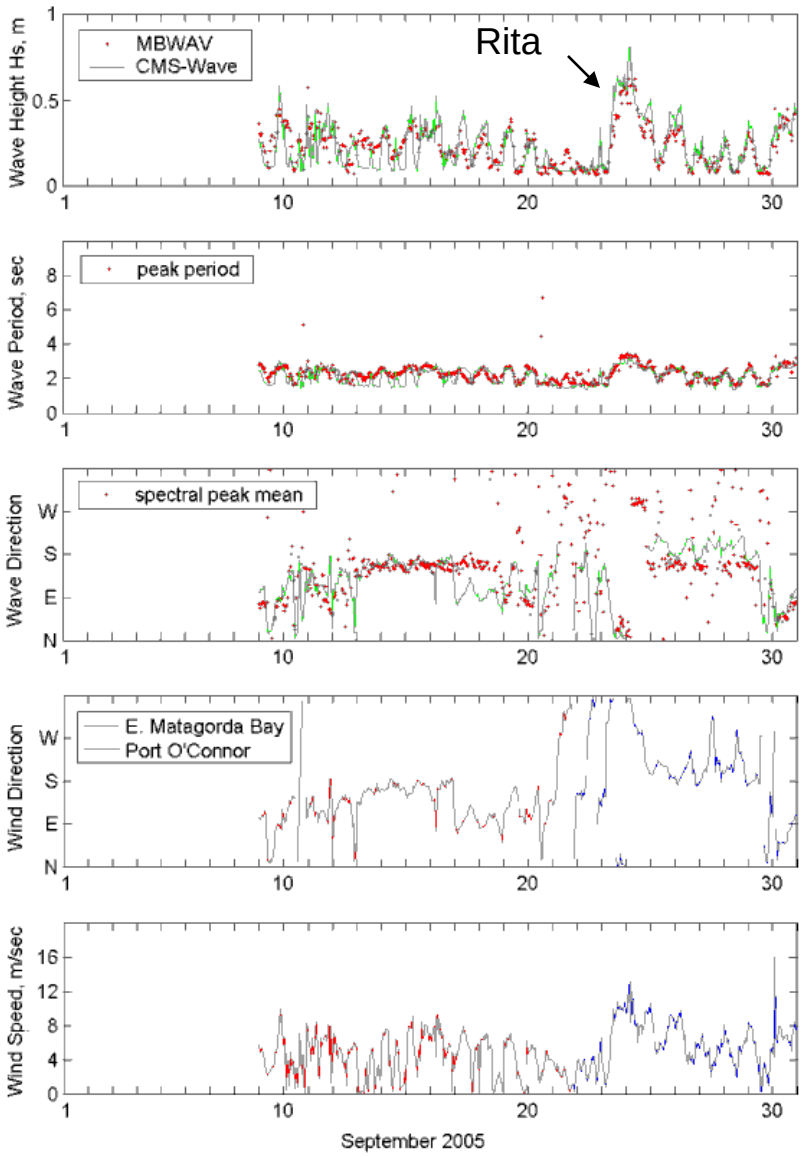
Wave run-up: rush of waves up a slope or structure

Two-percent run-up, *R2* : the vertical up-rush level exceeded by 2-percent of the larger run-up height

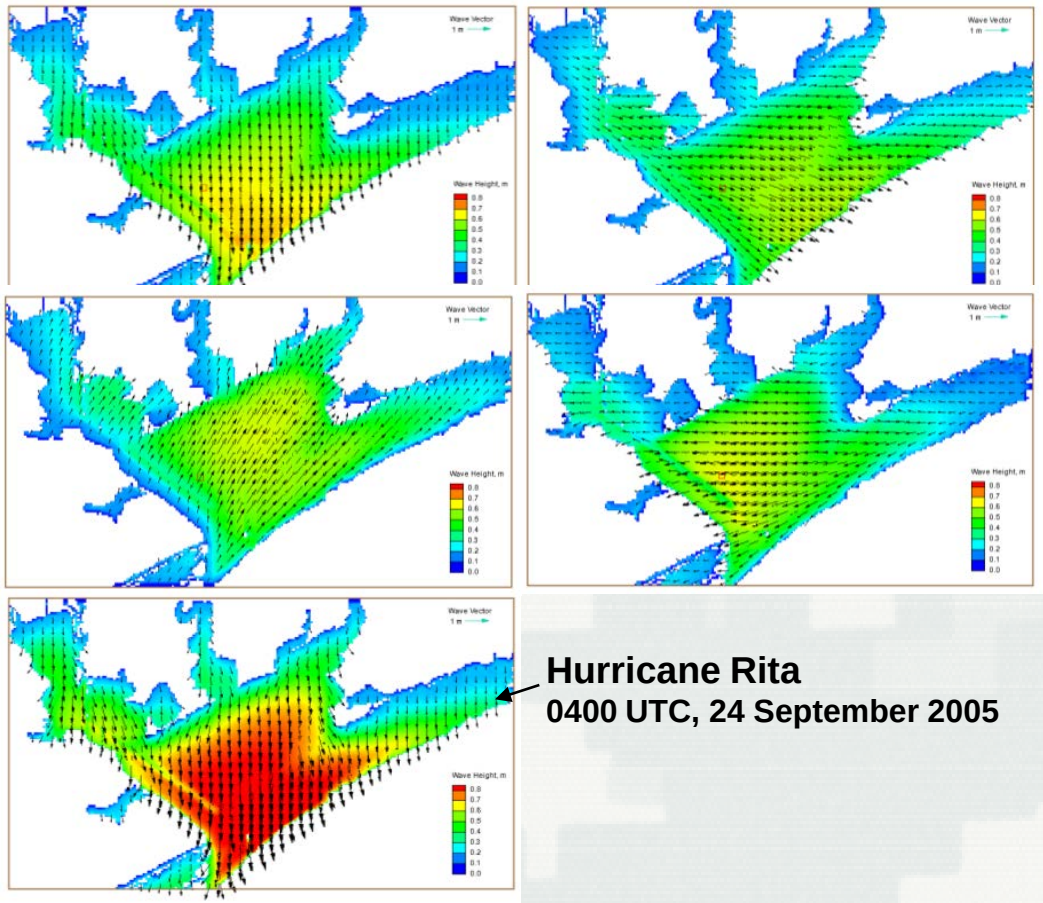
Ahrens & Titus (1981), Mase & Iwagaki (1984) ~ 400 laboratory experiments



Wave Generation

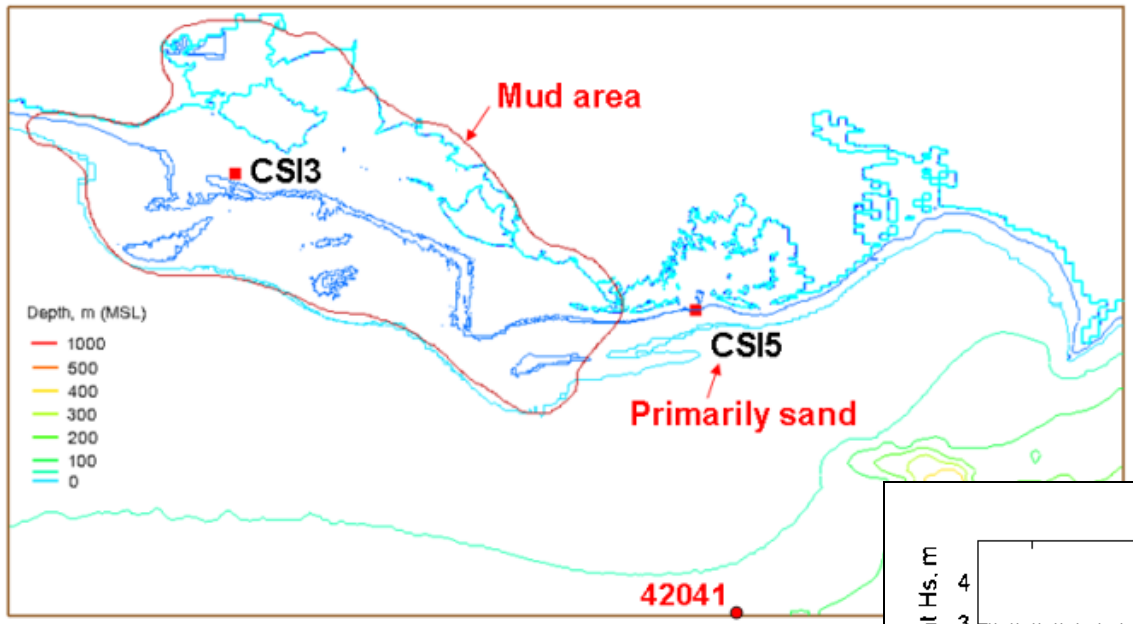


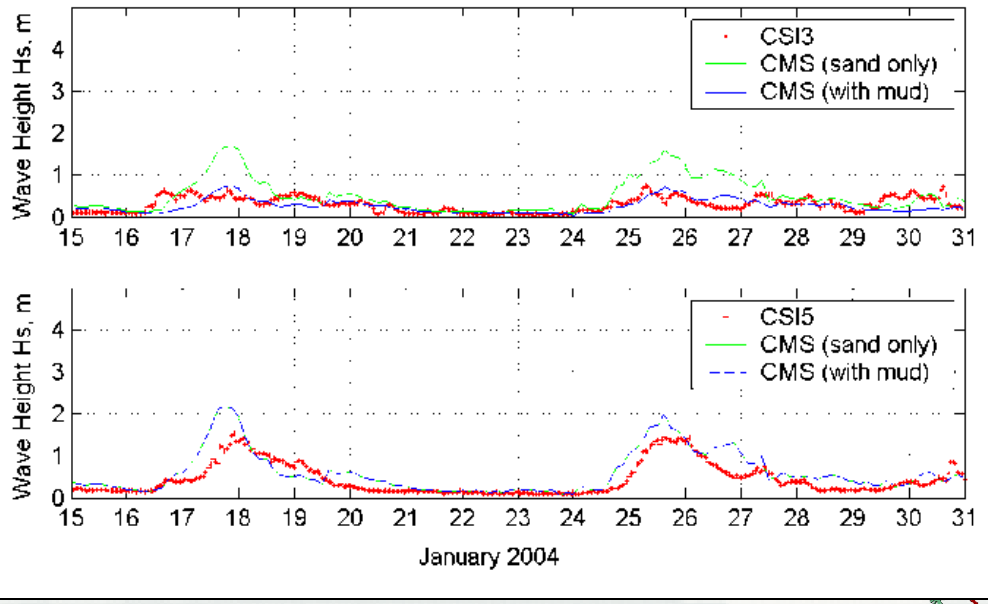
Matagorda Bay, TX



Hurricane Rita
0400 UTC, 24 September 2005

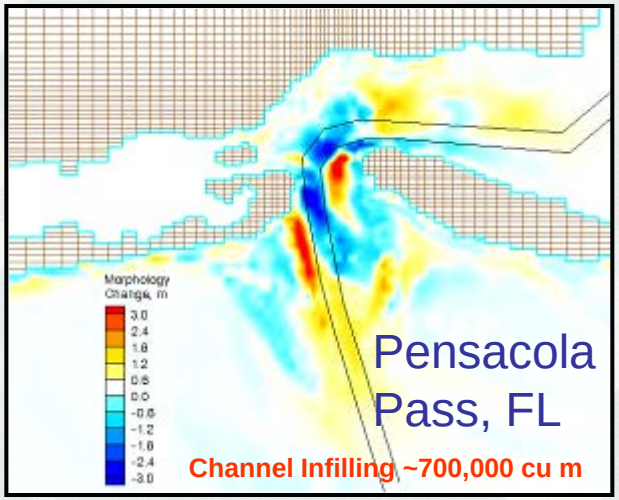
Wave Dissipation over Muddy Coast

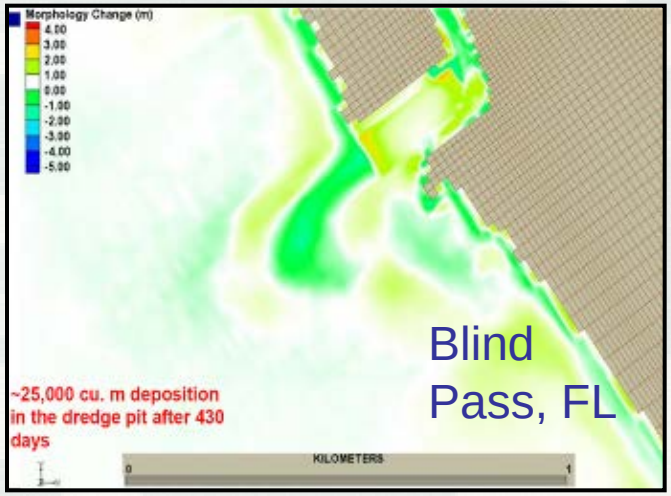




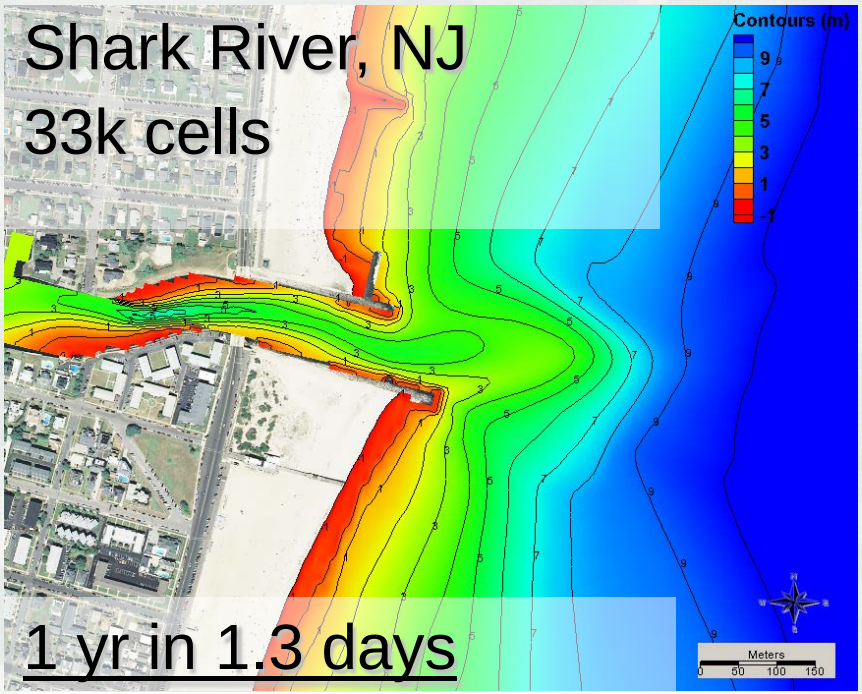
Sediment Transport: Key features

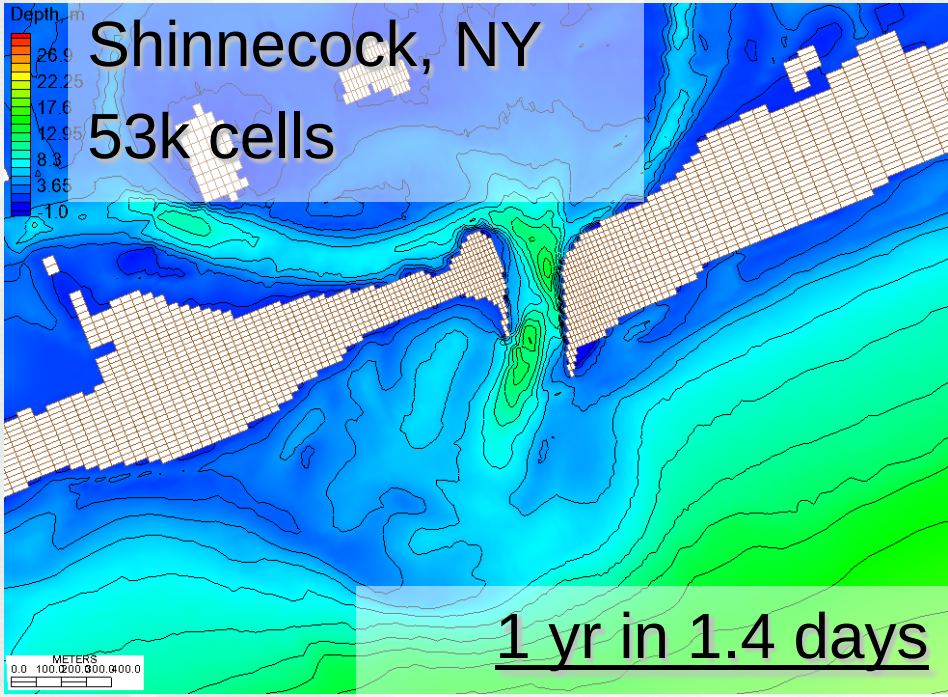
- Sediment transport models
  - Equilibrium Total Load (Exner equation)
  - Eq. Bed Load + Advection-Diffusion (AD) Suspended Load
  - Non-Eq. (AD Total Load)
- Sediment transport formulas
  - Lund-CIRP
  - Van Rijn
  - Watanabe
  - Soulsby
- Hard-bottom
- Avalanching
- Bed slope influence on bed load
- Multiple-sized sed. transport (NEW)

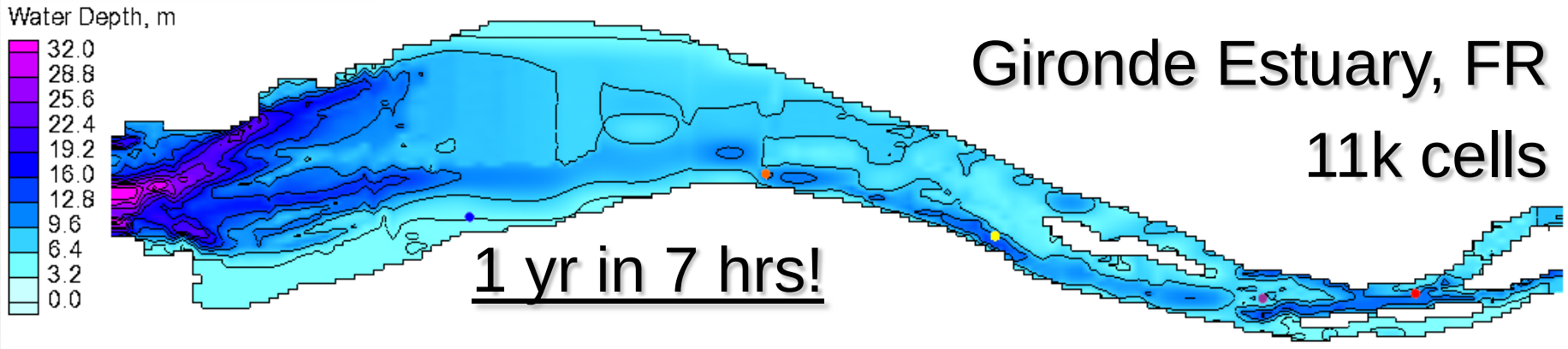




Computational Speed (Implicit)

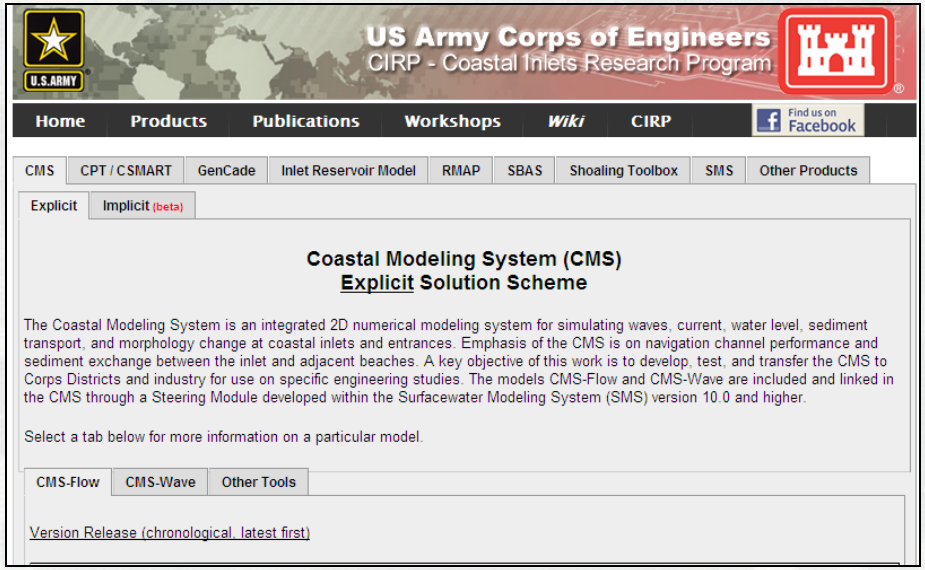






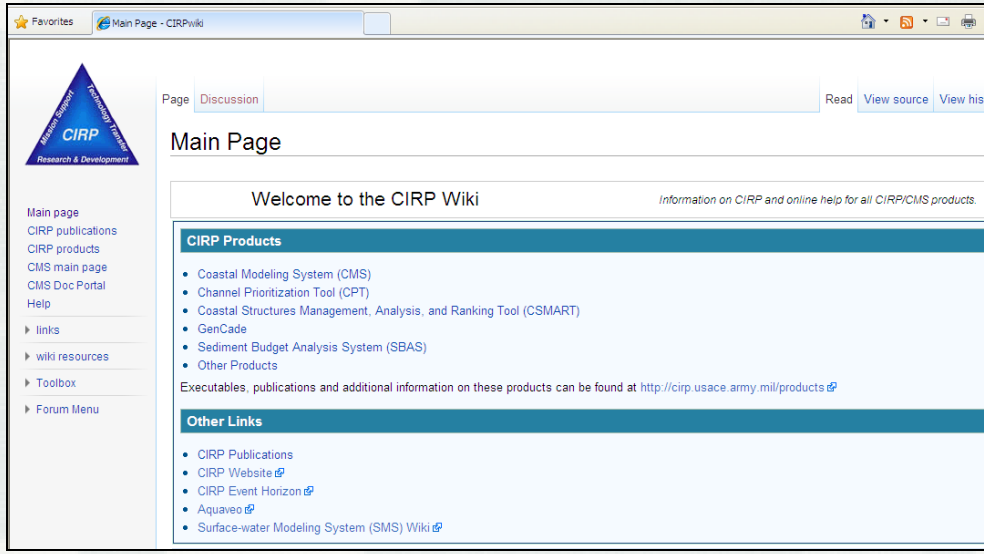
Documentation

- CIRP website



http://cirp.usace.army.mil/

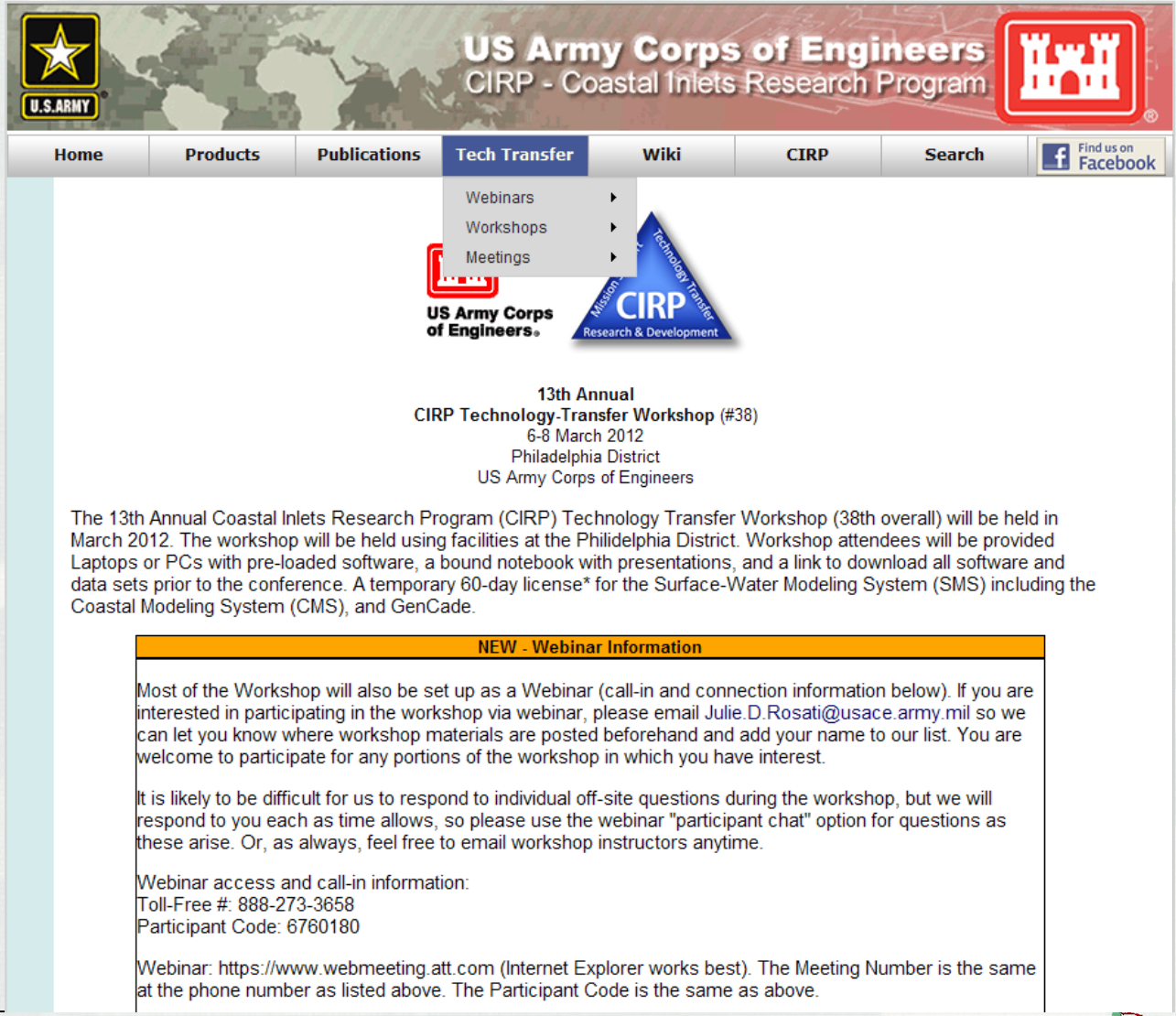
- CIRP Wiki



http://cirp.usace.army.mil/wiki/

Documentation
Website

- Products
  - CMS
  - GenCade
  - Others
- Publications
  - Technical Reports
  - CHETNS
  - Journal Articles
  - Others
- Tech Transfer
  - Upcoming
  - Recent



Documentation
Wiki

- CMS
  - Documentation Portal
  - Tutorials
  - Technical Info (Equations)
  - Validation Cases
- Gencade
  - Information
  - User Guide
- CPT/CSMART
  - Information and Guidance

Channel Portfolio Tool (CPT)

POC: Dr. Kenneth Ned Mitchell
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US Army Engineer Research and Development Center (ERDC)
Coastal and Hydraulics Lab (CHL)

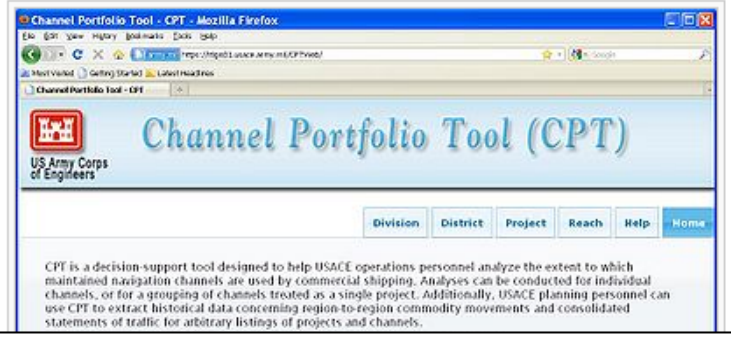
Active URL (Corps machines only): https://itlgis01.usace.army.mil/CPTWeb/

CPT is developmental software that is updated frequently.

CPT general layout

Setting the level of analysis (Reach, Project, District, Division)

CPT is designed to enable analysis of commercial utilization of the Corps-maintained waterway infrastructure at a variety of coverage levels. At the most detailed level, individual channel sub-reaches may be chosen for analysis and compared to other sub-reaches in the USACE portfolio of navigation projects. However, in order to provide decision support to personnel at all levels of Corps management, CPT can also be used to analyze and compare commercial usage figures at the Project, District, and Division levels. For example, a District program manager might want to see which navigation project under his or her control handles the most exports of a particular commodity. CPT pulls from a large database that is maintained by the Corps' Waterborne Commerce Statistics Center (WCSC). Setting the desired level of analysis is done through the CPT Home screen: https://itlgis01.usace.army.mil/CPTWeb/ . Figure 1 shows the four levels of analysis provided by CPT; the desired level is chosen by simply clicking on the respective link.



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Questions?

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